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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 23[1]

A REVISION OF THE GENUS *EMBALLONURA* (CHIROPTERA)

BY G. H. H. TATE AND RICHARD ARCHBOLD

Material accumulated over a number of years together with specimens obtained by the 1933 and 1936 Archbold New Guinea Expeditions and from the Whitney South Sea Expedition, augmented by the generous loan of their *Emballonura* by several of the large museums of the United States, have contributed to the preparation of this short revision of the genus *Emballonura*.

We are indebted for the loan of specimens to Dr. G. M. Allen, Museum of Comparative Zoölogy, Mr. G. S. Miller, Jr., U. S. National Museum, and Dr. W. H. Osgood, Field Museum of Natural History. Our thanks are due also to the directors of the European museums at Genoa, Berlin, Leiden, London and Paris for permission given in 1937 to study and photograph types of certain species of mammals in their care. Photographs and notes[2] were made in Europe from types or cotypes of the following: *Emballonura beccarii*, *cor*, *fuliginosus*, *furax*, *meeki*, *clavium*, *locusta*, *monticola*, *nigrescens*, *solomonis*, *papuana*, *raffrayana*, *rivalis* and *stresemanni*.

The line drawings illustrating a number of the species, show with a high degree of accuracy the several lines of development taken in those portions of the cranium (rostrum, sphenoid area, etc.) regarded as diagnostic. At the same time the remarkable degree of uniformity of the dentition can be noted. It is regretted that the photographs of many types (a millimeter scale included with each), though useful as enlarged prints for the preparation of this paper, are not sufficiently clear to be valuable for publication as half-tones.

A short series of measurements appears at the end of the paper for comparison of the skulls of types, cotypes and representative specimens.

Miller[3] pointed out that *Emballonura* must be considered the most primitive living genus in the family Emballonuridae. Besides being the only genus to retain two upper incisors, it lacks all trace of wing pouches and its skull in comparison with the skulls of most other emballonurid genera has remained comparatively simple in structure. In *Emballonura* the deep posterior wall of the basisphenoid pits (basial pits of Thomas) noticeable in most allied genera is either absent (*semicaudata*, *sulcata*, *atrata*) or relatively little developed. Among other genera that structure is simple only in *Rhynchiscus* of America, all others having the basisphenoid pits strongly specialized. *Rhynchiscus* also is devoid of wing-sacs. The tendency for development of lateral pits separated from the sub-medial pits by raised septa appears to be characteristic of the entire family; for in that respect the pits of the American *Saccopteryx* and *Peropteryx* differ from each other in much the same way as the pits of Gray's subgenus *Mosia* differ from those of *Emballonura monticola*.

The family Emballonuridae is a very old one whose geographical distribution from the standpoint of numbers of genera is today chiefly neotropical. At the same time since no genus is common to both hemispheres, we may perhaps infer that requirement of strictly tropical conditions for continued existence prevented passage since early tertiary times by the usual Bering Sea route between Asia and America.

[1] Earlier papers of the "Results of the Archbold Expeditions," dealing with mammals are numbers 1, 2, 3, 4, 5, 8, 9, 13, 16, 17, 18.

[2] Descriptions of types in quotation marks are from notes made by author.

[3] Miller, 1907, "Families and Genera of Bats."

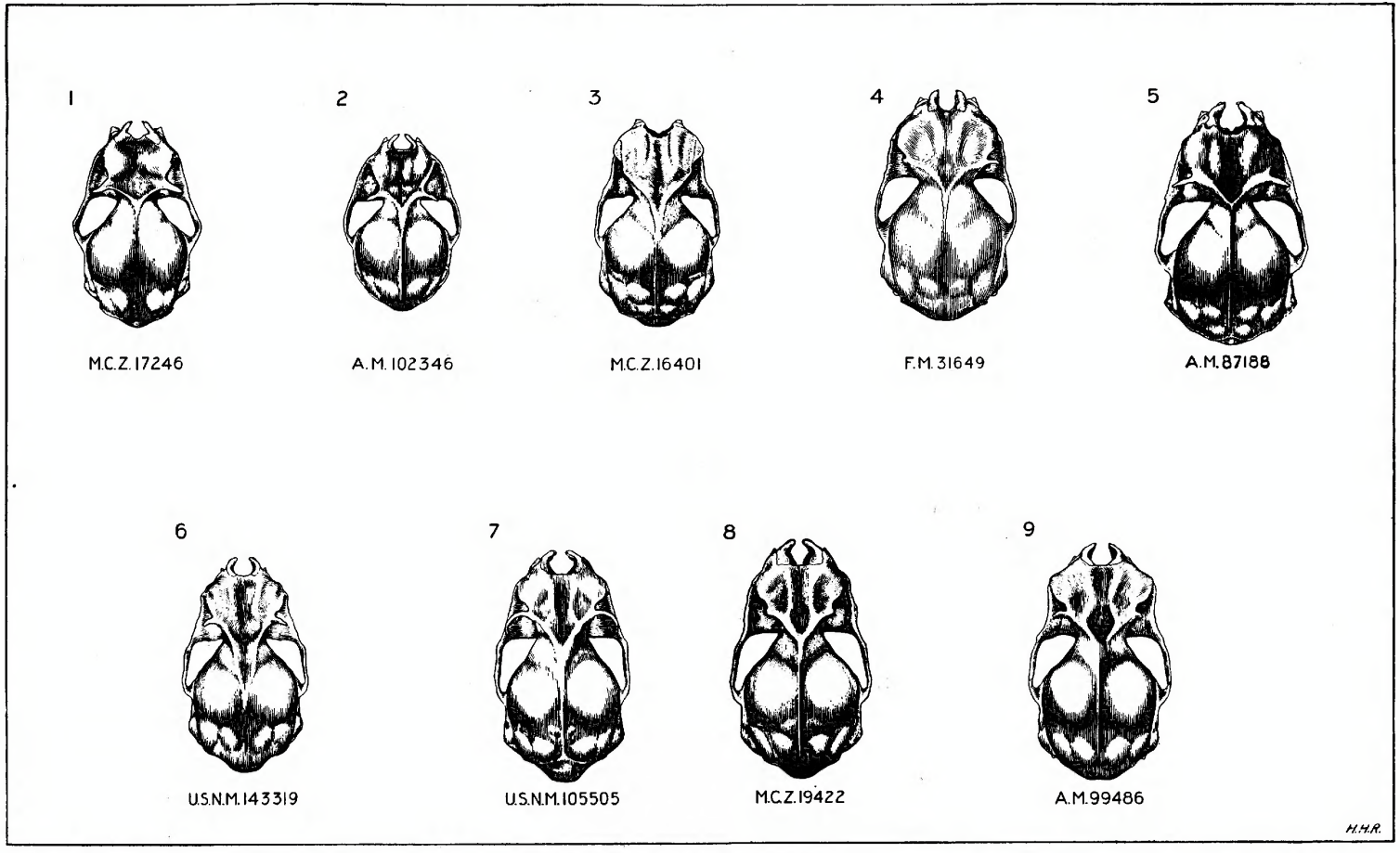


Fig. 1. Dorsal views of skulls.

No. 1, *Emballonura solomonis;* No. 2, *papuana;* No. 3, *atrata;* No. 4, *semicaudata;* No. 5, *sulcata;* No. 6, *monticola;* No. 7, *alecto;* No. 8, *rivalis;* No. 9, *cor.*

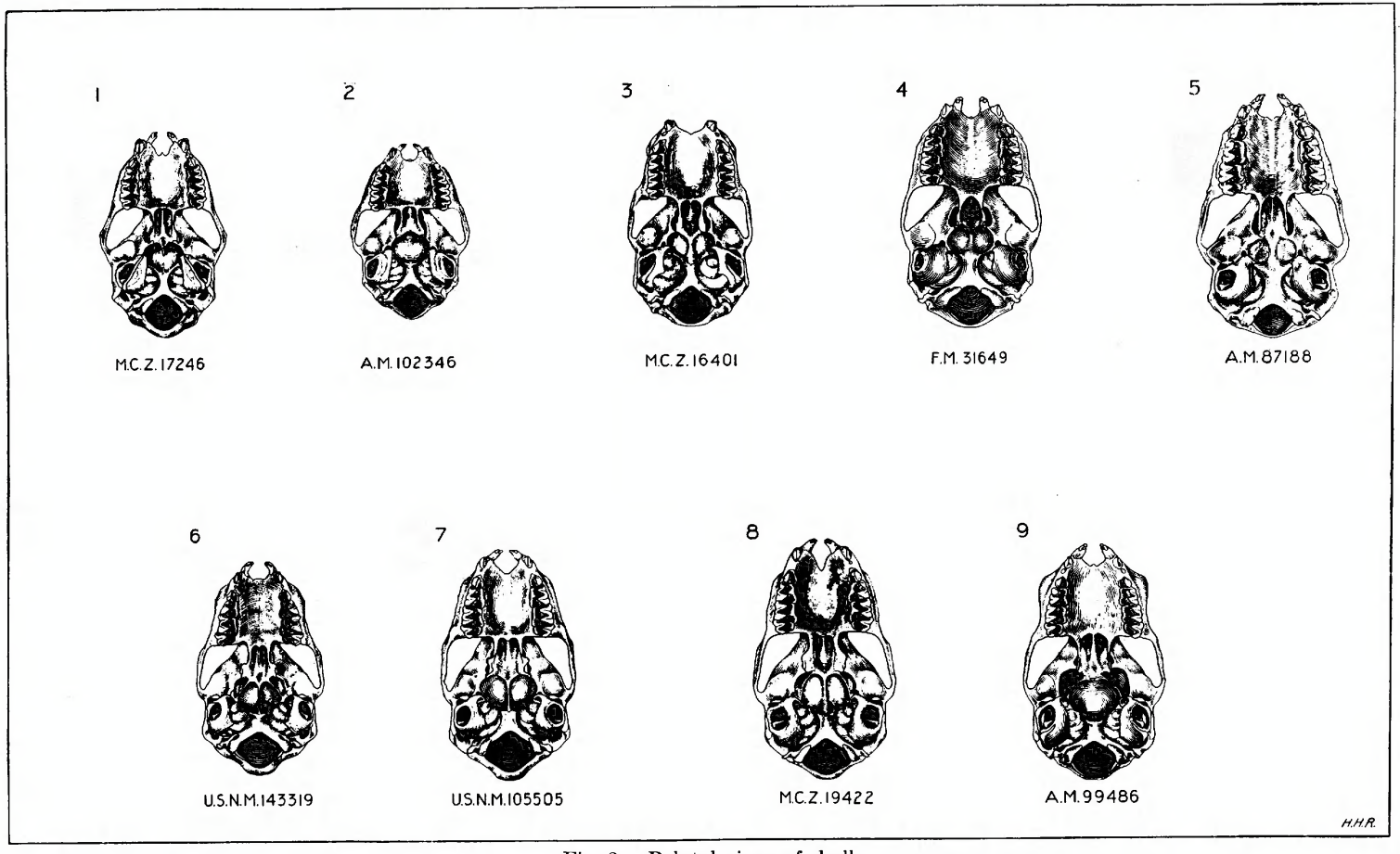


Fig. 2. Palatal views of skulls.

No. 1, *Emballonura solomonis;* No. 2, *papuana;* No. 3, *atrata;* No. 4, *semicaudata;* No. 5, *sulcata;* No. 6, *monticola;* No. 7, *alecto;* No. 8 *rivalis;* No. 9, *cor.*

Specializations common throughout the family are the broadened, often inflated rostrum, strongly developed postorbital processes and sphenoidal pits. The presence or absence of wing pouches (secondary sexual characters, at least in part) may be held to represent either specialization from a simple condition or simplification from a special adaptation. If the former view is taken *Emballonura* may be considered in this respect a primitive member of its family. The same considerations hold with the basisphenoid recesses and the characters of the rostrum. Lacking evidence to the contrary, simple structures are best considered primitive, rather than retrogradations from complex structures which had to be acquired in the first place. Absence of wing sacs and simplicity of cranial characters then are here treated as primitive.

As originally erected by Temminck (1839), *Emballonura* included members of the New World genera *Rhynchiscus*, *Peropteryx* and *Centronycteris*. Miller (1907) has shown that *monticola* of Java alone of Temminck's four original species is truly an *Emballonura* and must be considered the genotype. In 1839 Eydoux and Gervais described *alecto* from Luzon (held by Dobson, 1878, to be a synonym of *monticola*). Gray (1844) next described *Mosia nigrescens* from Amboina (*Mosia* was treated by Dobson as a subgenus of *Emballonura*). Peale (1848) named *semicaudata* from Samoa (and Tomes, 1859, obtaining specimens of the same bat from Fiji named them *fuliginosa*). Peters in 1861 described *discolor* from the Philippines and in 1874, *atrata* from Madagascar. (Sclater's *madagascariensis*, 1864, was a *nomen nudum*). Thus until 1875 only five species of *Emballonura* have been described. All of them are thoroughly valid species as measured by present day standards.

The years 1878 and 1880 marked the naming of *raffrayana* Dobson and *beccarii* Peters and Doria. In 1896 Thomas described *meeki*. In the twentieth century the following names were proposed: *anambensis* and *peninsularis* Miller, 1900; *solomonis* Thomas, 1904 (*Mosia*); *pusilla* Lyon, 1911; *sulcata* Miller, 1911; *furax* Thomas, 1911; *papuana* Thomas, 1914 (*Mosia*); *stresemanni* Thomas, 1914; *rivalis*, *clavium*, *cor* Thomas, 1915; *locusta* Thomas, 1920; *palauensis* Yamashima, 1932; and *palawanensis* Taylor, 1934.

List of Type Localities of *Emballonura*

alecto Eydoux and Gervais, 1839	Manila, Luzon
anambensis Miller, 1900	Anambas Isl.
atrata Peters, 1874	Madagascar
beccarii Peters and Doria, 1880	Jobi Isl.
cor Thomas, 1915	Choiseul Isl.
clavium Thomas, 1915	Kei Isl.
discolor Peters, 1861	Paracali, Luzon
fuliginosus Tomes, 1859	Fiji Isl.
furax Thomas, 1911	Kapari R., Dutch New Guinea
locusta Thomas, 1920	Schouten Isl.
madagascariensis Sclater, 1864	*nomen nudum*
meeki Thomas, 1896	Kiriwina, Trobriand Isl.
monticola Temminck, 1839	Munara Mts., Java
nigrescens Gray, 1844	Amboina
palauensis Yamashima, 1932	Palau Isl.
palawanensis Taylor, 1934	Palawan Isl.
papuana Thomas, 1914	Mimika R., Dutch New Guinea
peninsularis Miller, 1900	Trong, Lower Siam
pusilla Lyon, 1911	Kendawangan R., S.W. Borneo
raffrayana Dobson, 1878	"Gilolo"[1]
rivalis Thomas, 1915	Bida, Sarawak
semicaudata Peale, 1848	Samoa
stresemanni Thomas, 1914	West Ceram
solomonis Thomas, 1904	Florida Isl.
sulcata Miller, 1911	Vola Isl., Truk group, Caroline Isl.

The named forms are now considered referable to a rather limited number of species and species groups as follows:

1.—*atrata* group
  a.–*atrata*
2.—*Mosia* group
  b.–*nigrescens*
  c.–*solomonis*
  d.–*papuana*
3.—*semicaudata* group
  e.–*semicaudata* (= *fuliginosa*)
4.—*sulcata* group
  f.–*sulcata*
5.—*monticola* group
  g.–*monticola*, with synonyms *peninsularis* and *pusilla*

[1] Trouessart states Melfor Isl., Geelvink Bay, see Thomas, 1914, Ann. Mag. Nat. Hist., (8) XIII, p. 442.

h.–*alecto*, with synonyms *discolor*, *palawanensis*, *rivalis*, *anambensis*
j.–*beccarii* with races *meeki* and *clavium*
6.—*raffrayana* group
k.–*raffrayana* with races *cor* and *stresemanni*
l.–*furax*

The bats named *E. semicaudata palauensis* Yamashima from Palau comprising 4 males and 7 females possibly include more than one species, as their head-plus-body lengths are shown as 40 to 47 mm., and their forearms as 39 to 44.5 mm. Furthermore the Caroline group of islands including Palau is known as an overlap region for the species *sulcata* and *semicaudata*. Yamashima offered no detailed descriptions of the skulls.

The *monticola* group is characterized by possession of a heart-shaped, basisphenoid depression in the base of the skull, commonly more or less divided by a median septum into equal right and left halves and in some forms into four parts by the addition of lateral supplementary septa (see figure 2). The rostral region (from above) is only moderately expanded in relation to the width of the skull as a whole, while the median sulcus is but slightly deeper behind than anteriorly. The lateral rostral expansions are rather well inflated and rounded towards their lateral as well as their anterior margins. The dentition, despite some differences in the distance of the canine from the molariform teeth, remains very constant in character, and as between species and species varies chiefly in size.

The *raffrayana* group, besides showing optimum development of the sphenoidal recesses has the posterior portion of the pits deeply recessed above the anterior margin of the basioccipital bones and in some species the lateral ones recessed into the alisphenoids. The rostral expanse is proportionately increased as a whole and the rostral wings of the maxillary are relatively flat, uninflated, and rounded only anteriorly. They are usually perforated by many small pores. The median rostral sulcus is strongly developed and the bats are often smaller than those of the *monticola* group.

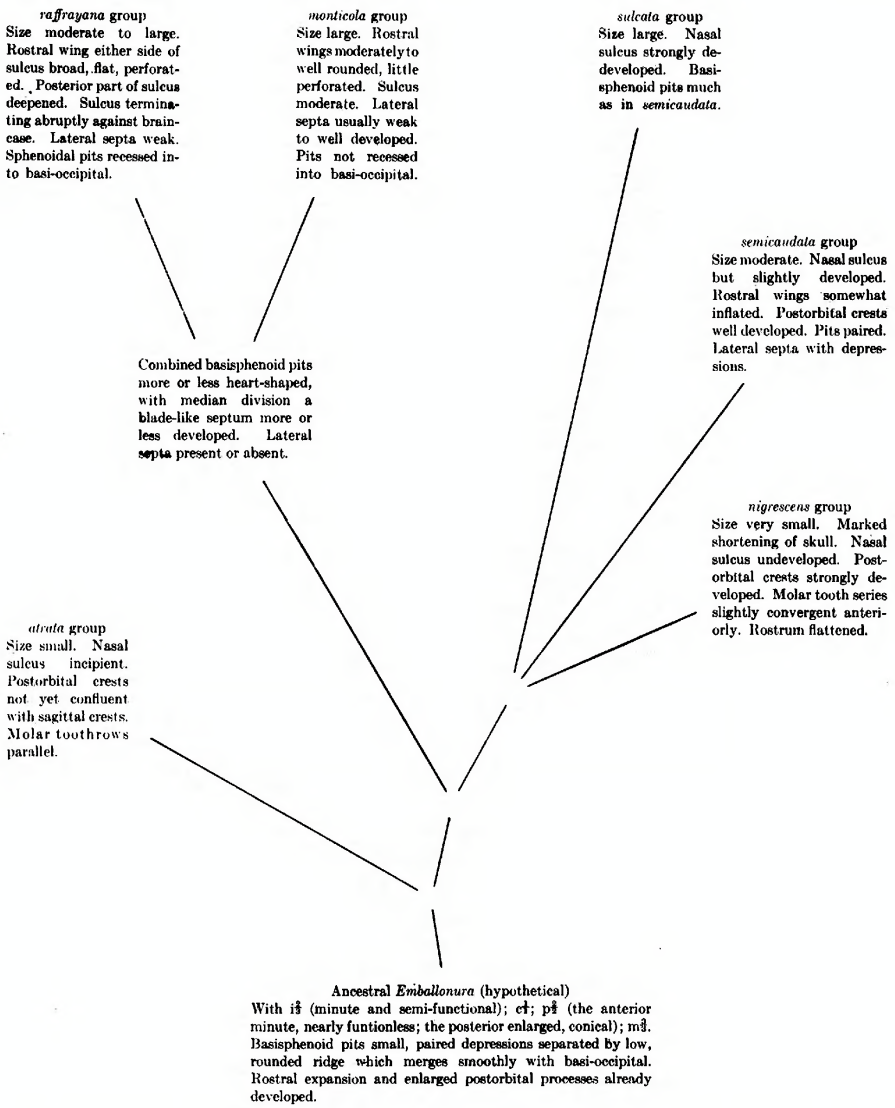
The *sulcata* group, though its rostral characters are closely similar to those of *raffrayana*, has a different arrangement of the basisphenoid region: the median septum is low and rounded; it passes smoothly into the basi-occipital; while the pits are a pair of small, rounded depressions with no trace of lateral septa.

The *semicaudata* group, smaller in size than *sulcata* has a not dissimilar arrangement of the sphenoidal pits, though in it the median septum is blade-like instead of broadly rounded as in *sulcata*. The rostral area is only slightly inflated, while the longitudinal sulcus is weakly developed to obsolescent.

The *atrata* group possesses paired rounded sphenoidal depressions separated by a low median ridge. The posterior, inner margin of the tympanic ring is excised. The median rostral trough passes smoothly up to the sagittal crest instead of ending abruptly as in other species at the junction of the postorbital crests with the sagittal crest.

From most viewpoints *atrata*, *nigrescens* and *semicaudata* (rather widely separated morphologically from each other) appear to be more simply constructed than members of the groups *monticola*, *sulcata* and *raffrayana*. The former three have simple sphenoidal conditions, and relatively simple rostra. The latter exhibit various special modifications. The three former ones are geographically peripheral in relation to the present general dispersal center for the genus (the Sunda-Malay region).

The Madagascar species *atrata*, in which the fronto-rostral region is somewhat less typically emballonuroid than in the others may be assumed to lie closest to the ancestral stem. In such cases the phylogeny of the genus may be expressed somewhat as follows:


raffrayana group
Size moderate to large. Rostral wing either side of sulcus broad, flat, perforated. Posterior part of sulcus deepened. Sulcus terminating abruptly against braincase. Lateral septa weak. Sphenoidal pits recessed into basi-occipital.
monticola group
Size large. Rostral wings moderately to well rounded, little perforated. Sulcus moderate. Lateral septa usually weak to well developed. Pits not recessed into basi-occipital.
sulcata group
Size large. Nasal sulcus strongly developed. Basisphenoid pits much as in semicaudata.
semicaudata group
Size moderate. Nasal sulcus but slightly developed. Rostral wings somewhat inflated. Postorbital crests well developed. Pits paired. Lateral septa with depressions.
Combined basisphenoid pits more or less heart-shaped, with median division a blade-like septum more or less developed. Lateral septa present or absent.
nigrescens group
Size very small. Marked shortening of skull. Nasal sulcus undeveloped. Postorbital crests strongly developed. Molar tooth series slightly convergent anteriorly. Rostrum flattened.
atrata group
Size small. Nasal sulcus incipient. Postorbital crests not yet confluent with sagittal crests. Molar toothrows parallel.
Ancestral Emballonura (hypothetical)
With i¾ (minute and semi-functional); c1; p¾ (the anterior minute, nearly funtionless; the posterior enlarged, conical); m3. Basisphenoid pits small, paired depressions separated by low, rounded ridge which merges smoothly with basi-occipital. Rostral expansion and enlarged postorbital processes already developed.

Emballonura atrata Peters

Emballonura atrata PETERS, 1874, Monatsber. k. Preuss. Akad. Berlin, p. 693.

TYPE.—Not seen.

MATERIAL.—These specimens, one without locality (U.S.N.M. 63331), two from Tanandra River (M.C.Z.). No specimen of *Emballonura* was collected by Archbold while in Madagascar. At the British Museum a single specimen (92.2.9.2) was found.

In the original description Peters pointed out the great length of the ears of this rare species, combined with its otherwise small size. The forearm ("lower part of arm") was given as 38 mm. The sex of the type was ♀. No cranial dimensions were given.

Grandidier and Petit (1932) state that the bat occurs in the center of the island of Madagascar.

Emballonura nigrescens (Gray)

Mosia nigrescens GRAY, 1843, Ann. Mag. Nat. Hist., (1) XI, p. 117.

TYPE.—B.M. 42.11.22.26, ad. ♂ in alcohol, studied and skull photographed.

COLLECTOR.—E. Belcher in "South America" (Gray). The skull label now reads "Amboina, East Indies."

MATERIAL.—Photograph of the type only.

Almost all of the bats currently identified as *nigrescens* are in reality *papuana*, the species with short, broad skull, which extends from Celebes to the Solomon Islands. True *nigrescens* (if the skull now marked as type in the British Museum was really extracted from Gray's specimen) is apparently much rarer. Our photograph and measurements indicate an animal with skull proportionately longer and narrower than that of the common *papuana*. The small size of the animal, the characters of the structure of the nostrils, the minute hind foot and the short forearm nevertheless indicate the relationship of the two species.

The type locality is probably open to question, as the evidence which led to the selection of Amboina is not extant.

The following notes on the type skull were made at the British Museum: "rostrum broad, flat; a slight rostral sulcus; frontal region slightly depressed; braincase rather narrow; basisphenoid region with shallow, median septum, no trace of lateral septa." The skin (still in alcohol) has been fully described by Gray and again by Dobson (1876, 1878).

Emballonura solomonis Thomas

Emballonura nigrescens solomonis THOMAS, 1904, Ann. Mag. Nat. Hist., (7)XIV, p. 200.

TYPE.—B.M. 1.11.5.8, ad. ♀, studied and skull photographed.

COLLECTOR.—A. S. Meek at Florida Island, Solomon Islands.

MATERIAL.—Among the Solomon Islands series in The American Museum of Natural History which comprises specimens from the islands of Savo, Pavuvu and Bauro, I am unable to match the large size of the type specimen of *solomonis*. This animal which has been re-studied, re-measured and photographed, averages 10 per cent larger than either the type of *papuana* or any of the Solomon Islands material just mentioned, of which the largest forearm is 34 mm. and the greatest zygomatic width is 7.6 (in the type of *solomonis*, 37 and 8.2 mm., respectively). However, three specimens in the Field Museum (33665–6, 33696) with forearms 37 mm. and a series of 15 in the Museum of Comparative Zoölogy, appear strictly referable to *solomonis*. The series discussed by Troughton[1] with forearms 36 to 38 mm. evidently also represents true *solomonis*.

Note made from the type skull: "a well-marked frontal depression, broader than long; nasal depression deep, oval in outline; palate broader than in *nigrescens;* median septum of sphenoidal pits almost obsolete."

Emballonura papuana Thomas

Emballonura papuana THOMAS, 1914, Ann. Mag. Nat. Hist., (8) XIII, p. 443.

TYPE.—B.M. 11.11.11.13, ad. ♂, studied and skull photographed.

COLLECTOR.—C. H. B. Grant at Wakatimi, Mimika River, Dutch New Guinea.

MATERIAL.—An abundance of specimens of this smallest of *Emballonurae* (see remarks under *nigrescens* and *solomonis*) is at hand.

Northeast Celebes: Teteamoet (1, U.S.N.M.).

South Celebes: Mengkoka Mountain (1, A.M.N.H.).

Halmahera: Ake Lomo (1, A.M.N.H.), Ternate (3, M.C.Z., without skulls).

Papua: Fly River (series, A.M.N.H.).

Mandated Territory: Astrolabe Bay (2, U.S.N.M.).

Kei Islands (2, U.S.N.M.).

Solomon Islands (series, A.M.N.H.).

This is not only the smallest known species of *Emballonura* but it shows maximum broadening and shortening of the skull. The following are characters of the type skull: "rostrum broad, unperforated, relatively flat; the frontal depression relatively broad and shallow, with a faint rostral sulcus; postorbital processes placed far back; no diastemata between c, p^1, p^2; sphenoidal pits taken together almost oval in outline with only a trace of the median septum."

In the upper Fly River region these tiny bats were seen to fly well before dusk at the topmost tiers of the rain forest in

[1] Troughton, 1936, Records Austral. Mus. XXIX, pp. 352–3.

openings between the trees. In the middle Fly country however they were collected repeatedly in the early mornings in the foliage of smaller forest palms from 6 to 20 feet above the ground.

Emballonura semicaudata (Peale)

Vespertilio semicaudatus PEALE, 1848, U. S. Exploring Exped., VIII, p. 23.

Emballonura fuliginosa TOMES, 1859, Proc. Zool. Soc. London, p. 77.

The type of *semicaudatus*, U.S.N.M. 3729, dried from alcohol, skull extracted and lost.

The type of *fuliginosa*, B.M. 58.12.27.7, was studied and photographed. Collected by F. M. Rayner, H.M.S. "Herald," at Ovalau, Fiji.

MATERIAL.—Ample series from Samoa and Fiji; a few from Marshall Island (F.M.N.H.); New Hebrides (1, M.C.Z.).

The characters of the skull of *semicaudata* have been compared by Miller[1] with those of *sulcata*. The following notes are from the type skull of *fuliginosa:* "braincase and back of skull broken. Muzzle broad, perforated with small pores; sphenoidal parts missing."

Emballonura sulcata Miller

Emballonura sulcata MILLER, 1911, Proc. Biol. Soc. Wash., XXIV, p. 161.

TYPE.—U.S.N.M. 151567. Collected at Uolo, Truk group, Caroline Islands.

MATERIAL.—The type, and one specimen from Ponape (A.M.N.H.). Thomas (1915) earlier recorded a specimen from Ponape.

This species, still rare in collections, occupies a rather isolated position morphologically.

Monticola Group

The following is an attempt to key out the *monticola* bats:

1.—Size small, forearm less than 40 mm.; sphenoidal region with median septum well or poorly developed, or bifid; rostral expansions strongly swollen; rostral sulcus shallow, more or less hour-glass-shaped; m^{1-3} less than 4.7 mm. ..... *beccarii* and subspecies.

Size larger, forearm more than 40 mm.; sphenoidal area with one or three septa moderately or weakly developed; rostral expansion, though rounded, not swollen; sulcus generally shallow and straight; m^{1-3}, 5.0 mm. or more ..... *monticola, alecto.* 2.

2.—Ante-molar portion of face and palate short; forearm, 42–45 mm ..... *monticola, peninsularis, pusilla.*

Ante-molar portion of face long; forearm 45–48 mm ..... *rivalis, anambensis, alecto, palawanensis.*

Emballonura monticola Temminck

(reference under subspecies)

Named forms referable to this short-palated species are the following:

peninsularis Miller from Trong, Lower Siam
monticola Temminck from Java
pusilla Lyon from extreme S.E. Borneo

The general range of the species has been indicated earlier. It is found also on the Natuna Islands.

Emballonura monticola monticola Temminck

Emballonura monticola TEMMINCK, 1839, Tijdschr. v. Natuur. Gesch., V, pp. 25–27.

Emballonura peninsularis MILLER, 1898, Proc. Acad. Nat. Sci. Philadelphia, p. 323.

Emballonura pusilla LYON, 1911, Proc. U. S. Nat. Mus., XL, p. 132.

COTYPES.—Skins "a" and "b," Leiden, with skulls inside; also skull "a" not marked "type." At Leiden, Dr. Junge kindly had the skull extracted (1937) from skin "a" for study. This skull, photographed, is then a true cotype of *monticola*. Back of skull broken away, palate, teeth and rostrum alone remain. Collector: Kuhl and van Hasselt at Mt. Munara, Java (skin "b," collector: de Boie). The two skins "a" and "b" are specimens mounted with wings expanded and with their skulls still inside the skins, after the fashion prevalent in Temminck's time. The separate skull marked "a" lacks a skin. All three are now considered cotypes and presumably were so treated by Temminck when he drew up the original description. To clarify the situation we now select specimen "a" (skin with newly extracted skull) as type of the species.

Specimen "a," Leiden, is described in my notes as follows: "ears pointed,

[1] Miller, 1911, Proc. Biol. Soc. Wash., XXIV, p. 161.

slightly falcate; tragus not visible; free part of thumb, c.u. 4.5 mm.; calcar, 14 mm." The colors of the pelage are now so faded as to be valueless. "Nasal trough broad and shallow; no rostral perforations."

Type of *peninsularis* U.S.N.M. 83575, ad. ♂.

COLLECTOR.—W. L. Abbott, Trong, Lower Siam.

Miller's comparison of *peninsularis* with "*monticola*" in his original description (*op. cit.*, p. 325) is subject to some modification in view of observations taken recently from the cotypes of *monticola* at Leiden. The forearm lengths of specimens "a" and "b" both come to 44.5 mm. Miller, quoting Temminck,[1] gave 40 mm. But in that reference the forearm measurement is given as "1 dm. 7 lijnen," which transposed at 25.4 mm. per inch gives the result 43.3 mm. The forearm measurement taken from the cotypes is virtually the same that Miller showed for *peninsularis* (43–45). The other two measurements quoted from Temminck which are much less reliable than forearm lengths are "total length" and "tail."

Type of *pusilla* Lyon, U.S.N.M. 153940, ad. ♀.

COLLECTOR.—W. L. Abbott from Mankol, Kendawangan River, S.W. Borneo.

Lyon compared *pusilla* with the Bornean bats which Thomas in 1915 named *rivalis*. He determined the S.E. Bornean material as "*monticola*" and named the smaller southwestern bats, *pusilla*. Under the present arrangement all Bornean *Emballonura* are held to be *E. rivalis*, except "*pusilla*" bats which are considered equal to *monticola* of Java.

MATERIAL.—Apart from the photograph of the cotype there appears to be no specimen in America from Java.

Lower Siam: Trong (few specimens in U.S.N.M.).
Mergui Archipelago: (small series in U.S.N.M.).
Butang Islands: (small series in U.S.N.M.).
North Sumatra: (small series in U.S.N.M.).
Islands west of Sumatra: (adequate series in U.S.N.M.).
Johore: (short series)
Rhio Archipelago: (adequate series U.S.N.M.).
Banka and Billiton: (few specimens each in U.S.N.M.).
Natuna Islands: (few specimens U.S.N.M.).
S.W. Borneo: (few specimens, including type of *pusilla*, U.S N.M.).
S.E. Borneo: Saratok River (series U.S.N.M.).
S. Celebes: (1, A.M.N.H.).
S.E. Borneo: Pangkallahan (few, U.S.N.M.).
S.E. Borneo: Klumpang Bay (series, U.S.N.M.).

The synonymizing of *peninsularis* with *monticola* is prompted by study of original material. As indicated already, Miller's separation of *peninsularis* was founded upon the assumption that *monticola* was a much smaller animal than it actually is. The present arrangement allows *monticola* a very extensive geographical range whose northwestern limits are suggested by British Museum records from Tenasserim.

Emballonura alecto Eydoux and Gervais

(references under subspecies)

The following named forms should in my opinion be placed under this species, in which the anterior or premaxillary portion of the palate is markedly longer than in *monticola:*

alecto Eydoux and Gervais from Manila
discolor Peters from Paracali, Luzon
palawanensis Taylor from Palawan Island
rivalis Thomas from Sarawak
anambensis Miller from Anambas Island

These long-skulled bats occur also on Karimata Islands.

Emballonura alecto Eydoux and Gervais

Emballonura alecto EYDOUX AND GERVAIS, 1839, Voyage autour du Monde, V, p. 7.

Emballonura discolor PETERS, 1861, Monatsber. Akad. Wiss. Berlin, p. 711.

Emballonura anambensis MILLER, 1900, Proc. Wash Acad. Sci., II, p. 236.

Emballonura rivalis THOMAS, 1915, Ann. Mag. Nat. Hist., (8) XV, p. 140.

Emballonura alecto palawanensis TAYLOR, 1934, Philippine Land Mammals, p. 197.

The type specimen of *alecto* was not studied (it is presumed to be in the Paris Museum with the skull still inside) but the assumption has been made that our material from Banay Island, adjoining Luzon, represents it morphologically. Comparison of the Banay skulls with our photograph of the cotype of *discolor* in the British Museum reveals no differences. A co-

[1] Temminck, 1838, Tijdschr. v. Natuur. Gesch., V, p. 25.

type of *discolor*, B.M. 7.1.1.568, ad., from the Tomes collection marked "Luzon," body in alcohol, not studied but the skull studied and photographed.

Type of *rivalis*, B.M. 3.11.2.2, ad. ♂, studied and skull photographed.

COLLECTOR.—C. J. Brooks, Bida, Sarawak.

Type of *palawanensis* not seen.

Type of *anambensis*, U.S.N.M. 101716, ad. ♀ from Pulo Mobur, Anambas Islands studied.

MATERIAL.—Philippines: Guimaras, south of Banay (series in U.S.N.M.); Capiz Banay (1,U.S.N.M.).

Sarawak: Mt. Lunda (series, M.C.Z.), River Baram (3, M.C.Z.), Tinjar River (series, M.C.Z.). S.W. Borneo: S. Matan (a few, U.S.N.M.); Anambas Islands (series, U.S.N.M.); Karimata Islands (series, U.S.N.M.); Panebangan Island (5, U.S.N.M.). Eastern Borneo: Loa Ban Ban, Markham River (3, U.S.N.M.); Moeratua Island, east of Borneo (2, M.C.Z.). N. Celebes: Likeopang (series, U.S.N.M.). E. Celebes: Peling Island (few U.S.N.M.).

From notes made on the type of *discolor:* "frontal depression and rostral trough as in *rivalis;* slight perforation of rostrum; sphenoidal pits with well-developed median septum but scarcely a trace of lateral septa."

Notes prepared from type skull of *rivalis:* "distant frontal depression, narrowing anteriorly to rostral sulcus; no definite perforations of rostral expansions; sphenoidal pits shallow, with three well-defined septa; a well-marked diastema between the second p and the minute, peg-like first p."

Close and careful comparison of the Guimaras material with representative skulls from the list of specimens shown above and with the photographs of types reveals no distinction between *alecto, rivalis* and *anambensis. Palawanensis* is referred only doubtfully to synonymy. The slightly larger size of the type of *rivalis* is held to be individual, as other Sarawak material falls short of it in regard to dimensions. Besides, there is some individual variation through the series.

Emballonura beccarii Peters and Doria

Named forms referable to this species are:

beccarii Peters and Doria from Jobi Island
locusta Thomas from Schouten Island
clavium Thomas from Kei Island
meeki Thomas from Trobriand Islands

Emballonura beccarii beccarii Peters and Doria

Emballonura beccarii PETERS AND DORIA, 1880, Annali Mus. Civico de Genova, XVI, p 693.
Emballonura meeki locusta THOMAS, 1920, Ann. Mag. Nat. Hist., (9) VI, p. 534.

The type of *beccarii*, Genoa (field number) 153A, ad. ♂, skin in alcohol, skull extracted 1937, studied and photographed.

COLLECTOR.—Beccari at Ansus, Jobi Island.

The type of *locusta*, B.M. 26.10.23.2, ad. ♀, body in alcohol, skull clean, studied and photographed.

COLLECTOR.—Pratt Brothers, from Schouten Island.

From notes made on type skull of *beccarii* at Genoa: "a median longitudinal nasal trough; nasal inflations showing perforations; sphenoidal cavity heart-shaped, with median septum well-developed, lateral ones weakly developed."

Concerning the type of *locusta* "rostral swellings as in *meeki* but flatter; sulcus broad, deep, and only slightly widened as it approaches the frontals; sphenoidal pits shallow, imperfectly separated; the median septum, which is broad and undivided anteriorly becomes obsolete from the middle of the pits posteriorly."

I have little doubt, after studying the types, that *beccarii* and *locusta* should be synonymized. As I am still uncertain concerning the proper status of *clavium* and *meeki*, they have been allowed to remain subspecies. Available material for study is so scanty that one cannot decide with certainty whether the differences described by Thomas are valid or not. On the evidence now available they are valid. Apparently *meeki* is further set off from *beccarii* than *clavium* is.

Emballonura beccarii clavium Thomas

Emballonura meeki clavium THOMAS, 1915, Ann. Mag. Nat. Hist., (8) XV, p. 137.

TYPE.—B.M. 10.3.1.34, ad. ♀, skin and skull studied and skull photographed.

COLLECTOR.—W. Stalker, at Ara, Kei Islands.

MATERIAL.—Photograph of the type only.

From notes on the type skull: "nasals as in *meeki* (i.e., swollen); only middle and posterior end of hour-glass-shaped depression (in *meeki*) developed; sphenoidal pits shallow, indistinctly divided by three low septa."

Emballonura beccarii meeki Thomas

Emballonura meeki THOMAS, 1896, Novit. Zool., III, p. 527.

TYPE.—B.M. 96.10.5.12, ad. ♂, in alcohol, skull clean, studied and skull photographed.

COLLECTOR.—A. S. Meek at Kiriwina Island, Trobriand Group.

PARATYPES.—B.M. 96.10.5.13–14, skulls extracted, in alcohol.

MATERIAL.—Photograph of the type and A.M.N.H. 104027 from Mafulu, Central Division of Papua.

Meeki, the most easterly member of the *monticola* group, is distinguished by its small size and by the increased degree of inflation of the rostral wings. The following additional data were drawn up from the type skull: "fronto-nasal sulcus hour-glass-shaped; no perforations of nasal inflations; sphenoidal pits shallow, indistinct; the median septum heavy, low, double—not reaching back of sphenoidal area but giving off a pair of indistinct lateral septa; upper incisors and their supporting premaxillae forming a straight line with fronts of canines."

Emballonura raffrayana Dobson

(references under subspecies)

Although *raffrayana* and *cor* come from opposite ends of the Papuan region they are scarcely separable and must be considered at best representative races of the one species. *Stresemanni* is exceedingly like *raffrayana*.

Emballonura raffrayana raffrayana Dobson

Emballonura raffrayana DOBSON, 1878, Proc. Zoöl. Soc. London, p. 876.

TYPE.—B.M. 79.10.6.2, ad. ♂, in alcohol, skull clean, originally from the Paris Museum, is marked "cotype, Mafor Island," studied and photographed.

MATERIAL STUDIED.—Photograph of the type. Dutch New Guinea: Weyland Mts. (2, A.M.N.H.).

From notes: "muzzle broad, flat, with small perforations; a strongly developed fronto-nasal trough with deepened portions at the intertemporal and nasal levels; sphenoidal pits heart-shaped, the median septum almost suppressed, lateral septa moderately developed; the lateral pits not recessed (compare *furax*)."

Emballonura raffrayana stresemanni Thomas

Emballonura stresemanni THOMAS, 1914, Ann. Mag. Nat. Hist., (8) XIII, p. 442.

TYPE.—B.M. 13.3.6.29, ad. ♀, in alcohol, skull cleaned, studied and skull photographed.

COLLECTOR.—E. Stresemann at Mt. Lumutai, West Ceram, 400 m.

A series of paratypes, B.M. 13.3.6.30–33 in alcohol.

MATERIAL.—Photograph of the type only.

From notes on the type taken at the British Museum: "related to *raffrayana* and *cor;* naso-frontal sulcus deep, of even width, with deeper portions at extreme ends; rostral perforations developed; sphenoidal pits taken together heart-shaped, their median and lateral septa weak, the pits strongly recessed against basioccipital."

Emballonura raffrayana cor Thomas

Emballonura cor THOMAS, 1915, Ann. Mag. Nat. Hist., (8) XV, p. 139.

TYPE.—B.M. 5.1.28.2, ad., skin and skull studied and skull photographed.

COLLECTOR.—A. S. Meek, Choiseul Island.

MATERIAL.—Photograph of the type. Tabar Islands (3, A.M.N.H.); Isabel Island (1, M.C.Z.).

Notes drawn up from type specimen: "close to *raffrayana;* fronto-nasal sulcus as in *raffrayana;* muzzle with expansions perforated; sphenoidal pits heart-shaped,

the median septum moderately developed, the lateral septa weak, the pits recessed against the basioccipital; lateral pits slightly recessed against alisphenoids."

Emballonura furax Thomas

Emballonura furax THOMAS, 1911, Ann. Mag. Nat. Hist., (8) VII, p. 384.

TYPE.—B.M. 11.11.11.12, ad. ♀, skin and skull studied, skull photographed.

COLLECTOR.—C. H. B. Grant at White Water Camp, Kapari River, Dutch New Guinea, 400 feet.

MATERIAL.—Photograph of the type only.

Notes on type skull: "back of braincase broken; rostrum low and flat, unperforated; rostral sulcus long and narrow; postorbital processes placed far forward; sphenoidal pits with three barely visible septa, the lateral pits well recessed within the alisphenoids."

The largest species of *Emballonura* known.

EMBALLONURA

MEASUREMENTS

	atrata M.C.Z. 16401	*nigrescens* (type) B.M. 42.11.22.26	*solomonis* (type) B.M. 1.11.5.8	*papuana* (type) B.M. 11.11.11.13	*semicaudata* (type) U.S.N.M. 3729	*fuliginosa* (type) B.M. 58.12.27.7	*sulcata* (type) U.S.N.M. 151567
Skin:							
forearm	38.0	33.0	36.2	32.0	41	44.0	48.4
Skull:							
condylo-canine length	12.2	11.5	12.5	10.6			
breadth rostrum	5.5	4.05	4.7	4.1		7.0	6.9
zygomatic breadth	7.7	7.0	8.2	7.6		9.0	9.9
breadth braincase	6.5	5.5	6.25	6.1		7.1	8.0
Teeth:							
crowns c–m^3	5.1	4.1	4.65	4.0		5.75	6.6
crowns m^{1-3}	3.1	2.5	2.8	2.55		3.45	3.7
m^1, length × breadth		0.95 × .8	1.0 × .95	0.9 × 1.0		1.3 × 1.3	1.5 × 1.7
m^2, length × breadth		1.0 × 1.0	1.1 × 1.1	1.0 × 1.1		1.6 × 1.6	1.4 × 2.0
m^3, length × breadth		0.85 × 1.1	0.85 × 1.2	0.8 × 1.5		1.15 × 1.4	1.2 × 1.8

	monticola (lectotype) Leiden, spec. a.	*pusilla* (type) U.S.N.M. 153940	*peninsularis* (paratype) U.S.N.M. 83575	*anambensis* (type) U.S.N.M. 101716	*rivalis* (type) B.M. 3.11.2.2	*discolor* (cotype) B.M. 7.1.1.568	*alecto* Guimaras Isl. near Banay. F.M. 47032	*palawanensis* (from Taylor)
Skin:								
forearm	44.5	44.0	43.5	44.7	48.0		45.0	46.0
Skull:								
condylo-canine length		12.0	12.0	13.0	14.0	13.5	13.0	
breadth rostrum	5.7	5.3	5.5	5.8	5.0	5.0	5.5	
zygomatic breadth		9.0	8.5	8.7	9.3	9.2	8.8	8.1
breadth braincase		6.5	7.0	7.0	7.2	7.3	7.0	
Teeth:								
crowns c–m^3	5.15	5.0	5.1	5.6	6.1	5.7	5.6	5.6
crowns m^{1-3}	3.3	3.1	3.2	3.3	3.3	3.4	3.4	
m^1, length × breadth	1.25×1.3	1.2 × 1.4	1.3×1.5	1.3 ×1.5	1.25 × 1.5	1.35×1.5	1.4×1.5	
m^2, length × breadth	1.1 ×1.5	1.1 × 1.7	1.3×1.7	1.25×1.75	1.3 × 1.7	1.3 ×1.75	1.2×1.7	
m^3, length × breadth	×1.45	× 1.45	1.1×1.5	1.1 ×1.5	1.15 × 1.6	1.1 ×1.6	1.1×1.5	

EMBALLONURA

MEASUREMENTS

	becarii (type) Genoa, 153A	*meeki* A.M.N.H. 104027 Mafulu, Papua	*meeki* (type) B.M. 96.10.5.12	*clavium* (type) B.M. 10.3.1.34	*locusta* (type) B.M. 20.10.23.2
Skin:					
forearm	37.0	38.0	38.0	38.0	37.0
Skull:					
condylo-canine length	11.2		12.0	11.4	11.2
breadth rostrum	5.5	5.7	5.7	5.2	5.5
breadth braincase	6.1	6.7	6.65	6.5	6.1
Teeth:					
crowns c–m^3	4.6		4.3	4.6	4.1
crowns m^{1-3}	2.7	3.0	2.45	2.7	2.5
m^1, length × breadth	0.9 × 0.95		0.8 × 1.0	1.0 × 1.05	0.9 × 1.05
m^2, length × breadth	1.0 × 1.1		1.0 × 1.1	1.0 × 1.25	0.8 × 1.15
m^3, length × breadth	0.7 × 1.1		0.85 × 1.2	0.95 × 1.2	0.8 × 1.1

	raffrayana (cotype) B.M. 79.10.6.2	*raffrayana* A.M.N.H. 101938 Derimapa	*raffrayana* A.M.N.H. 101939 Derimapa	*cor* A.M.N.H. 99486 Tabar Isl.	*cor* (type) B.M. 5.1.28.2	*cor* A.M.N.H. 99487 Tabar Isl.	*cor* A.M.N.H. 99485 Tabar Isl.	*stresemanni* (type) B.M. 13.3.6.29	*furax* (type) B.M. 11.11.11.12
Skin:									
forearm	40.0	40.5	42.0	42.0	37.0	40.0	42.0	41.0	47.0
Skull:									
condylo-canine length	13.0		12.4	12.8		13.0	12.7	13.8	17.0
breadth rostrum	6.5		6.8	6.6	6.75	6.6	6.5	7.0	8.0
breadth braincase	7.0	7.0	7.2	7.1	7.0	6.9	7.1	7.2	8.7
Teeth:									
crowns c–m^3	4.9				4.8			5.3	7.4
crowns m^{1-3}	3.0	3.1	3.15	3.2	3.1	3.3	3.3	3.3	4.3
m^1, length × breadth	1.0 ×1.2				1.1 ×1.2			1.3×1.45	1.4×1.7
m^2, length × breadth	1.1 ×1.35				1.1 ×1.4			1.3×1.5	1.5×2.0
m^3, length × breadth	0.95×1.5				0.95×1.35			1.2×1.5	1.5×1.5